

Sub
Q2

WE CLAIM:

1. A method of validating a connection mapped between first and second end-nodes via at least one intermediate node in a communications network, the method comprising the steps of:
 - a) at the first end-node, inserting performance monitor (PM) information into a predetermined location within the data signal;
 - b) at the at least one intermediate node:
 - i) extracting the PM information from the predetermined location within the signal received at the intermediate node;
 - ii) buffering the extracted PM information; and
 - iii) reinserting the buffered PM information into the predetermined location within the signal prior to transmitting the data signal toward the second end-node; and
 - c) at the second end-node, extracting the PM information from the data signal.
2. A method as claimed in claim 1, wherein the data signal contains a SONET/SDH SPE and the step of inserting the PM information comprises a step of inserting the PM information into a predetermined location within a transport overhead (TOH) outside of the SPE.
3. A method as claimed in claim 2, wherein each node in the network is adapted to support a plurality of connection layers and the connection is mapped on one of the plurality of connection layers.

4. A method as claimed in claim 3, wherein PM information respecting each layer is inserted into a respective predetermined location of the TOH.
5. A method as claimed in claim 1, wherein the step of inserting PM information comprises a step of inserting one or more of a Trace field; a Parity field; and an indicator field.
6. A method as claimed in claim 5, wherein the step of inserting a Trace field comprises inserting a nibble of a trace message for communicating information concerning the connection.
7. A method as claimed in claim 6, wherein the step of inserting the nibble of a trace message comprises a step of inserting successive nibbles of the trace message into respective successive signals until an entire trace message has been sent.
8. A method as claimed in claim 6, wherein the step of inserting a Trace field comprises repeating the trace message after the entire trace message has been sent.
9. A method as claimed in claim 5, wherein the step of inserting a parity field comprises a step of calculating a parity value in respect of a data signal, and inserting the parity value into a next data signal to be transmitted.
10. A method as claimed in claim 9, wherein the data signal contains a SONET/SDH SPE and the parity value is a BIP-8.

11. A method as claimed in claim 10, wherein the parity value is calculated starting after an H2 byte of a transport overhead (TOH) portion of the signal, and incorporates all SPE bytes until the H2 byte of a next data signal.
12. A method as claimed in claim 5; wherein the step of inserting an indicator field comprises a step of accumulating an error count in respect of the data signal.
13. A method as claimed in claim 12, wherein the data signal is a SONET/SDH signal and the error count is a BIP-8.
14. A method as claimed in claim 1, wherein the step of extracting the PM information comprises a step of extracting one or more of a trace field; a parity field; and an indicator field.
15. A method as claimed in claim 14, wherein the step of extracting a parity field further comprises a step of calculating a parity value in respect of the received data signal.
16. A method as claimed in claim 15, further comprising the steps of:
 - a) comparing the recalculated parity value with a received parity value contained in the extracted parity field to obtain an error count; and
 - b) XORing the error count with the received parity value.

17. A method as claimed in claim 16, wherein the step of buffering the PM information comprises the step of buffering the XOR result as a buffered parity value.
18. A method as claimed in claim 16, further comprising a step of accumulating the error count value in respect of the received data signal.
19. A method as claimed in claim 14, wherein the step of extracting an indicator field further comprises the steps of:
 - a) monitoring the indicator field of each successive received data signal; and
 - b) asserting an AIS state if the indicator field of each of a first predetermined number of successive data signals contains a first predetermined value.
20. A method as claimed in claim 19, further comprising a step of de-asserting the AIS state if the indicator field of each of the first predetermined number of successive data signals contains a value other than the first predetermined value.
21. A method as claimed in claim 19, wherein the first predetermined number of successive data signals is three.
22. A method as claimed in claim 19, wherein the first predetermined value is binary "1111".

23. A method as claimed in claim 14, wherein the step of extracting an indicator field further comprises the steps of:
- a) monitoring the indicator field of each successive received signal; and
 - b) asserting an RDI state if the indicator field of each of a second predetermined number of successive signals contains a second predetermined value.
24. A method as claimed in claim 23, wherein the predetermined number of successive data signals is three.
25. A method as claimed in claim 23, wherein the second predetermined value is binary "1100".
26. A method as claimed in claim 1, wherein the step of buffering the extracted PM information comprises double-buffering the extracted PM information.
27. A method as claimed in claim 1, wherein the step of reinserting the buffered PM information into the predetermined location within the signal overhead comprises a step of inserting one or more of a buffered trace field; a buffered parity field; and a buffered indicator field.
28. A method as claimed in claim 27, wherein the buffered trace field is inserted into the data signal without change.

29. A method as claimed in claim 27, wherein the step of inserting the buffered parity field comprises the steps of:
- a) calculating a parity value of an outgoing signal;
 - b) XORing the calculated parity value with the contents of the buffered parity field; and
 - c) inserting the XOR result into a successive outgoing signal.
30. A method as claimed in claim 27, wherein the step of inserting the buffered indicator field comprises a step of setting contents of the indicator field to a third predetermined value if an AIS state is has been asserted.
31. A method as claimed in claim 30, wherein the third predetermined value is binary "1100".
32. A method as claimed in claim 1, wherein the step of extracting the PM information at the second end-node comprises the step of extracting one or more of a trace field; a parity field; and an indicator field.
33. A method as claimed in claim 32, wherein the step of extracting the parity field further comprises a step of calculating a parity value in respect of the received data signal.
34. A method as claimed in claim 32, wherein the step of extracting an indicator field further comprises a step of accumulating an error count value in respect of the received data signal.

35. An apparatus for validating a connection mapped between first and second end-nodes via at least one intermediate node in a communications network, the apparatus comprising:
- a) a framer adapted for extracting performance monitoring (PM) information from a data signal being conveyed through the connection;
 - b) means for buffering the extracted PM information while the data signal is pointer processed; and
 - c) means for inserting the buffered PM information into the data signal prior to forwarding the data signal.
36. An apparatus as claimed in claim 35, wherein the data signal contains a SONET/SDH SPE and the PM information is inserted into a predetermined location within a transport overhead (TOH) outside the SPE.
37. An apparatus as claimed in claim 36, wherein each node in the network is adapted to support a plurality of connection layers and the connection is mapped on one of the plurality of connection layers.
38. An apparatus as claimed in claim 37, wherein PM information respecting each layer is inserted into a respective predetermined location in the TOH.
39. An apparatus as claimed in claim 35, wherein the PM information comprises one or more of a Trace field; a Parity field; and an indicator field.
40. An apparatus as claimed in claim 39, wherein the trace field comprises a nibble of a trace message for

communicating information concerning the OP-N connection.

41. An apparatus as claimed in claim 40, wherein successive nibbles of the trace message are inserted into respective successive signals until an entire trace message has been sent.
42. An apparatus as claimed in claim 40, wherein the trace message is repeated after the entire trace message has been sent.
43. An apparatus as claimed in claim 39, wherein the parity field contains a parity value calculated in respect of a previously forwarded data signal.
44. An apparatus as claimed in claim 43, wherein the data signal contains a SONET/SDH frame and the parity value is a BIP-8.
45. An apparatus as claimed in claim 44, wherein the parity value is calculated starting after an H2 byte of a transport overhead (TOH) portion of the signal, and incorporates all SPE bytes until the H2 byte of a next data signal.
46. An apparatus as claimed in claim 39, wherein the indicator field comprises an accumulated error count in respect of the data signal.
47. An apparatus as claimed in claim 46, wherein the data signal comprises a SONET/SDH SPE and the error count is a BIP-8.

48. An apparatus as claimed in claim 35, further comprising:
- a) means for calculating a parity value in respect of the received data signal;
 - b) means for comparing the calculated parity value with a received parity value extracted from the parity field of the received data signal to generate an error count;
 - c) an XOR logic gate adapted to XOR the error count and the received parity value, the XOR result being s as the ; and
 - d) means for saving the XOR result as the buffered parity value.
49. An apparatus as claimed in claim 48, further comprising a memory for accumulating the error count in respect of the received data signal.
50. An apparatus as claimed in claim 39, further comprising:
- a) means for monitoring the indicator field of each successive received data signal; and
 - b) means for asserting an AIS state if the indicator field of each of a first predetermined number of successive data signals contains a first predetermined value.
51. An apparatus as claimed in claim 50, further comprising means for de-asserting the AIS state if the indicator field of each of the first predetermined number of successive data signals

contains a value other than the first predetermined value.

52. An apparatus as claimed in claim 50, wherein the first predetermined number of successive data signals is three.
53. An apparatus as claimed in claim 50, wherein the first predetermined value is binary "1111".
54. An apparatus as claimed in claim 39, further comprising:
 - a) means for monitoring the indicator field of each successive received signal; and
 - b) means for asserting an RDI state if the indicator field of each of a second predetermined number of successive signals contains a second predetermined value.
55. An apparatus as claimed in claim 54, wherein the predetermined number of successive data signals is three.
56. An apparatus as claimed in claim 54, wherein the second predetermined value is binary "1100".
57. An apparatus as claimed in claim 35, wherein the means for buffering the extracted PM information comprises a double-buffer.
58. An apparatus as claimed in claim 39, wherein the means for inserting the PM information comprises means for setting contents of the indicator field to

a third predetermined value if an AIS state is has been asserted.

59. An apparatus as claimed in claim 58, wherein the third predetermined value is binary "1100".